VIII. *Experiments on local Heat. In a Letter from* James Six, *Eſq. to the Rev.* Francis Wollaſton, *LL.B. F. R. S.*

Read January 10, 1788.

DEAR SIR,

THE following experiments are a continuation of thoſe I had the pleaſure of communicating to you ſome time ſince, relating to the diverſity of local heat in the atmoſphere; and confirm, in a more particular manner, my former obſervations reſpecting a remarkable refrigeration, which, in clear weather, takes place near the earth; for, although its ſurface in the day-time is then moſt liable to be heated by the ſun, yet after that is ſet, and during the night, the air is always found coldeſt near the ground, particularly in vallies. This phænomenon, for want of nocturnal obſervations, has been but lately noticed*; probably becauſe in the day-time, eſpecially when the

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* Within theſe few years.

Mr. Wilson, in the Philoſophical Tranſactions, 1780, p 467. and 1781, p. 368. deſcribing the effects of a ſevere froſt at Glaſgow, mentions a remarkable refrigeration, which he perceived to take place on the ſurface of the ſnow and hoar-froſt, which ſunk the mercury in a thermometer laid upon it many degrees lower than one ſuſpended twenty-four feet above it. This phænomenon, he ſays, *had recently come under obſervation*; but ſuppoſing (I preſume) the principle of refrigeration to operate only on the ſurface of the ſnow, or hoar-froſt, when the cold was ſevere, it does not appear he made experiments at any other time.

In

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the weather is ſtill and warm, the difference of temperature is reverſed, the reflection of the ſun's rays from the earth heating the air more below than it does above.

The experiments in my former Paper * were made partly in autumn, and partly in winter; and, the local variations differing in ſome meaſure with the ſeaſons, I was deſirous of continuing a ſeries of experiments throughout one entire year. To this end, therefore, I ſuſpended proper thermometers † in a ſhady northern aſpect, in the open air, at different heights; one in my garden at nine feet, and another in the Cathedral Tower 220 feet from the ground; continuing my journal, with the omiſſion of a few days only, from July 1784 till July 1785.

In the ſummer of 1783, making experiments with thermometers, which I had conſtructed to ſhew the greateſt degrees of heat and cold that happened in the obſerver's abſence, *I firſt perceived* this nocturnal refrigeration in the loweſt ſtratum of the atmoſphere; for by ſuſpending theſe thermometers at different altitudes, and viewing them only once in twenty-four hours, I found the true maximum and minimum of the heat and cold, which had happened during that time in their ſeveral ſtations.

A writer in the Gentleman's Magazine, for March 1785, p. 170, who did me the honour to mention my former Paper, containing *Experiments on Local Heat*, obſerved, that the effects of a ſharp froſt, which happened in *December of the preceding year*, appeared to be much more ſevere among the vegetables in the vallies than on the hills; and by taking the difference of temperature with thermometers at that time, he found them vary from 5 to 17 degrees, according to their ſeveral ſtations.

M. DE SAUSSURE, in his Voyages dans les Alpes, Vol. II. publiſhed 1786, ſays, "Quant à l'obſervation bien curieuſe *et bien nouvelle* de M. PICTET, que pendant la nuit la couche d'air la plus baſſe depuis la terre juſques a 5 pieds au-deſſus eſt plus froide que les couches ſuivantes depuis 5 pieds juſque a 50."

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* Philoſophical Tranſactions, Vol. LXXIV. p. 428.

† Conſtructed to give the true maximum and minimum that may happen in the obſerver's abſence. See Philoſophical Tranſactions, Vol. LXXII. p. 72.

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Fig. 1.

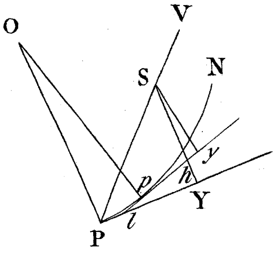
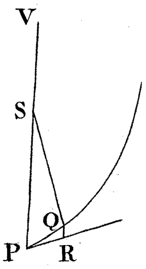


Fig. 2.



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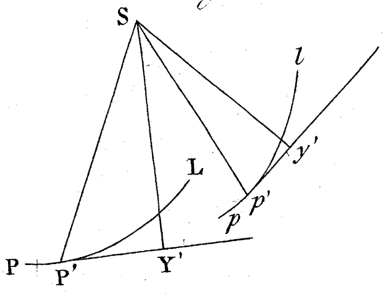

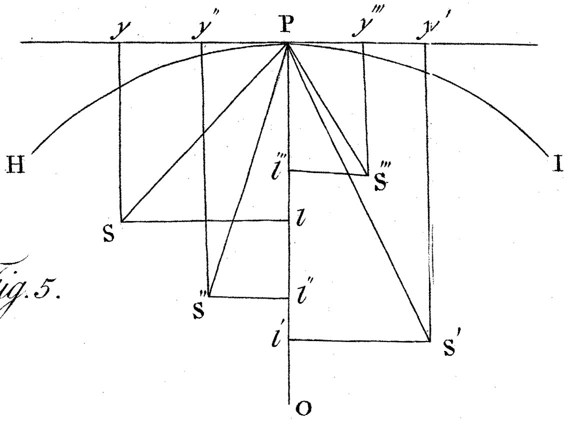

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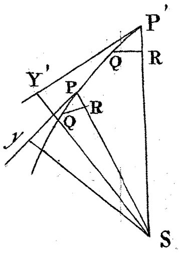

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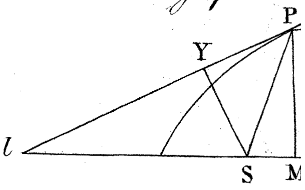

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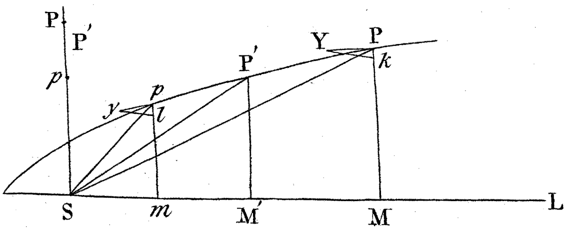


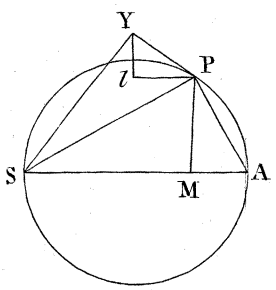
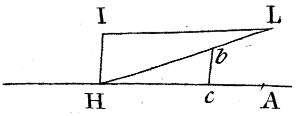


Fig. 10.

Fig. 11



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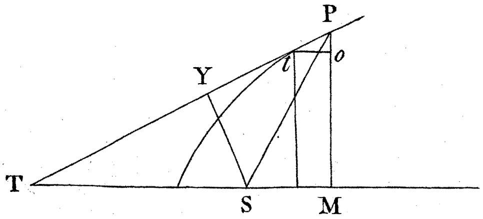

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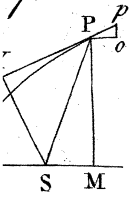

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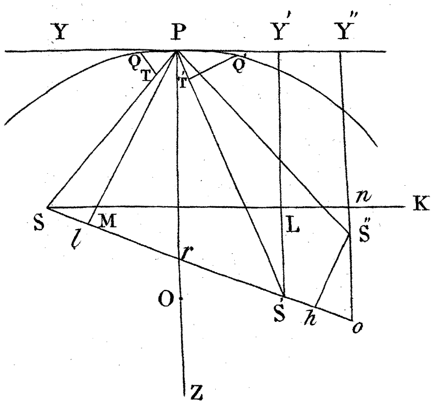
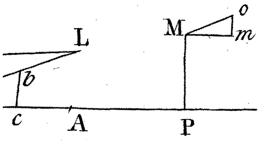


Fig. 11.



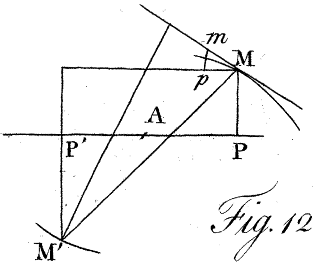


Fig. 12.

The reſult entirely correſponded with what I had before obſerved reſpecting the nocturnal diminution of heat, and the particular ſtate of the atmoſphere requiſite to produce it. The greateſt variations which happened within the year were in October and June; in the former month, the thermometers generally differed moſt in the night; in the latter, moſt in the day. From the 25th to the 28th of October, the heat below, in the night, exceeded, in a ſmall degree, the heat above, at which time there was frequent rain, ſometimes mingled with hail. From the 11th to the 14th, and alſo on the 31ſt, there was no variation at all; during which time likewiſe the weather was rainy; all the reſt of the month proving clear, the air was found colder below than it was above, ſometimes 9 or 10 degrees. In the month of June, the greateſt nocturnal variations happened from the 11th to the 15th, and from the 25th to the 30th; at both which times there appeared to be two currents of wind, the upper current from the S.W., the lower from the N.E.*. On cloudy nights, the loweſt thermometer ſometimes ſhewed the heat to be a degree or two warmer than the upper one; but in the day time the heat below conſtantly exceeded the heat above more than in the month of October. See Tab. I. and II. †.

Being

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* Sometimes theſe were rendered viſible by clouds in different ſtrata, moving in different directions, and at other times by clouds moving in a contrary direction to a very ſenſible current of air below.

† The obſervations of the wind and weather were taken at Canterbury. In all the tables, the nocturnal degrees of cold belong to the night immediately preceding the day to the date of which they are placed.—With my thermometer I have ſometimes ſuſpended hygrometers; but their movement, although as conformable as poſſible to the moiſture of the air, had not a ſufficiently regular correſpondence with the variation of the thermometers to be inſerted in the

tables

Being deſirous of knowing whether the nocturnal refrigeration increaſed on a nearer approach to the ſurface of the earth, I placed, in the midſt of an open meadow, on the bank of the river, near this city, two thermometers; one on the ground, and the other ſix feet above it; with theſe, and the two others before mentioned, one on the tower, and the other in my garden, I made obſervations from the 10th to the 23d of October, 1786. See Tab. III. But as the thermometer ſix feet from the ground, in the meadow, nearly agreed with that in the garden at nine feet, I have omitted an account of the latter in this table of compariſon. Here I found, as before, the nocturnal variations entirely regulated by the clearneſs, or the cloudineſs, of the ſky; and although they did not always happen in the ſame proportion to the reſpective altitudes, yet, when the thermometers differed at all, that on the ground was always the coldeſt.

Finding ſo conſiderable a difference as three degrees and a half, within ſix feet of the earth's ſurface, I increaſed the number of my thermometers in the meadow to four; one of them I ſunk in the ground, another I placed juſt upon the ground, a third I ſuſpended at three feet, and a fourth at ſix feet from the ground; at the ſame time I placed three thermometers in an open garden on St. Thomas's Hill, where the land is level with the Cathedral Tower, and about a mile diſtant from it; here I likewiſe put one in the ground, another juſt upon it, and ſuſpended a third ſix feet above it.

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tables of compariſon. It is true, when the weather was clear and not too cold, the upper ones indicated dryneſs more than the lower; but in froſty weather, the contraction and expanſion of the hygrometers being impeded by the froſt, they did not in any regular manner agree with the variations of the thermometer.

With

With theſe ſeven thermometers and the two, before mentioned, in the city, I continued a diary for twenty days, taking alſo every morning the temperature of the water in the river; but the weather proving cloudy ſoon after, the thermometers hardly varied at all, ſeven or eight days only excepted. After this time I never rectified them but when the appearance of the weather gave me reaſon to expect that they would vary conſiderably. See the obſervations that were then taken Tab. IV.; by which it appears, that the cold in the night was generally greater in the valley than that on the hill; but that the variations between the thermometers on the ground, and thoſe ſix feet above them, were often as great on the hill as in the valley.

Perceiving now, that a difference of temperature was frequently found within three feet from the ground, I reſolved to try ſtill nearer; but my thermometers being eighteen inches in height could not be applied ſo near to the ſurface of the earth as my experiment required; I therefore conſtructed two others for the particular purpoſe; and by bending down the large tube, the bulb or body of the thermometer, to an horizontal poſition, while the ſmaller tubes remained in a vertical one, I was enabled to aſcertain the different degrees of heat from the ground to a ſingle inch.

At certain times, when the weather was clear, I expoſed theſe two horizontal thermometers in an open place, ſuſpending one of them, ſo as to bring the body of it within an inch of the ground, and the other nine inches above it. When the variation among the other thermometers was conſiderable, I found alſo a difference between theſe; the lower one indicating ſometimes more than two degrees leſs heat than the upper one, although they were placed ſo near to each other. See Tab. V.

From the foregoing experiments it appears, that a greater diminution of heat frequently takes place near the earth in the night-time, than at any elevation in the atmoſphere within the limits of my inquiry; and that the greateſt degrees of cold are at ſuch times always found neareſt to the ſurface of the earth; that this is a conſtant and regular operation of nature, under certain circumſtances and diſpoſitions of the atmoſphere, and takes place at all ſeaſons of the year; that this difference never happens in any conſiderable degree but when the air is ſtill, and the ſky perfectly unclouded[*]; but the moiſteſt vapour, ſuch as dews and fogs[†], did not, as far as I could perceive, at all impede, but rather increaſe the refrigeration. In very ſevere froſts, when the air frequently depoſits a great quantity of frozen vapour, I have generally found it greateſt[‡]; but the exceſs of heat, which in day-time, in the ſummer ſeaſon, was found at the lower ſtation, in the winter diminiſhed almoſt to nothing.

The foregoing experiments related to the difference of heat, which, at certain times, is found at different altitudes; the following

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[*] Free from clouds which float higher in the air than fogs, and are ſufficiently opaque to hide the ſtars from our view even in the zenith.

[†] When fogs covered the valley, the refrigeration below was conſiderable; but they very ſeldom reached ſo high as the upper thermometer, and the ſky was clear above. No variation during rain, except mingled with hail.

[‡] This remarkable diminution of heat near the ſurface of the earth in clear weather, after the ſun is ſet, and in the night, proceeds, I apprehend, partly from the coolneſs which the dews or vapours poſſibly may acquire in their deſcent, and partly from the evaporation which takes place at the ſame time from all moiſt or frozen bodies expoſed to the open air, particularly from thoſe on which the dew or hoar froſt is depoſited.

following to the different degrees of heat obſerved at different ſituations in reſpect to the ſea-ſhore. Tab. VI. and VII. contain a ſet of correſponding obſervations; among which are thoſe you were ſo obliging as to take for me at Chiſlehurſt *; others at the ſame time were taken in my garden, and on the Cathedral Tower; and others on the ſea-ſhore, about ſeven miles N.N.W. from Canterbury, where the thermometer was ſuſpended about 40 feet above high-water mark, 14 from the ground, and about 100 yards from the ſea †.

By Tab. VI. it appears, that every night, one only excepted, during that time, the air was coldeſt at Chiſlehurſt; and that the mean heat at the ſea-ſhore was equal to that on the tower at Canterbury. In the month of June (Tab. VII.) it is remarkable, that the cold was ſtill greater in the night at Chiſlehurſt than at any of the other places, excepting where there appeared two currents of wind, the upper current from the S.W. and the lower from the N.E.; at which time alſo there was the greateſt difference between the thermometer in the garden and that on the tower.

Tab. VIII. contains obſervations taken only at particular times, when the weather was extremely cold; and ſhews how nearly at ſuch times the temperature in the night, at the ſea-ſhore, generally agreed with that on the Cathedral Tower; with this exception, however, that on the 18th, 21ſt, and 22d of February, 1784, a little ſnow falling at ſeveral times in the day, the evenings after being clear, and the wind at N.E., the thermometer on the ſea-ſhore, contrary to what uſually happened, gave the cold greater than the thermometer on the

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* The thermometer at Chiſlehurſt was ſuſpended twelve feet from the ground.

† The thermometer on the Cathedral Tower was elevated about 200 above that on the ſea-ſhore.

tower; but under ſimilar circumſtances I have ſince ſeen the ſame.

The following experiments relate to the variation of local heat in the earth itſelf; the diverſity of which appears from the different heat of the water iſſuing from it at different places*. It has been conjectured, that the diverſity of the temperature of ſprings may probably depend on their different elevations in the earth, with reſpect to the level of the ſea.

Two remarkably deep wells, both near the ſea-ſhore, and not far diſtant from Canterbury, gave me a favourable opportunity of making experimental inquiry into this matter; eſpecially as the ſituation of the two ſprings differed conſiderably from each other in reſpect to the level of the ſea. One of theſe is a well in Dover Caſtle, which is ſunk 360 feet through the high cliff of chalk on which the Caſtle ſtands, and the depth of the well is nearly equal to the height of the cliff from the ſea. The other is King's-Well at Sheerneſs†, which was ſunk 330 feet through almoſt one entire ſtratum of firm clay, where the ſurface of the ground is only four feet above high water.

Suppoſing therefore the ſpring in Dover well to lie level with the ſea, the ſpring of the well at Sheerneſs lies 326 feet below it; a circumſtance extremely favourable to my experiment. The temperature of the ſprings I took in the following manner.

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* The temperature here meant is not that of the very hot ſprings which proceed from particular local cauſes, ſometimes riſing near the ſurface of the earth; nor of ſprings which are near enough to the ſurface of the earth to be affected by the change of temperature in the atmoſphere; but that heat which being found at a great depth is more likely to be permanent, and may be ſuppoſed to originate from ſome general cauſe in the earth.

† See an account of ſinking this curious well by Sir THOMAS PAGE, Phil. Tranſ. Vol. LXXIV. p. 6.

After fathoming each well with a line and plummet, I let one thermometer down to the bottom, and fixed another on the line, ſo as to reach to half the depth only, keeping a third to take the temperature of the air at the top.

Degrees of heat in the wells.

Sept. 28, 1784. Temperature of the water in the new well in Dover Caſtle.		Oct. 6, 1784. Temperature of the water in King's Well at Sheerneſs.	
By thermometer at the top	56°	By thermometer at the top	53
By ditto at the middle	52	By ditto at the middle	51
By ditto at the bottom	48¾	By ditto at the bottom	56
Found the well 360 feet deep with 21 feet water.		Found the well 280 feet deep* with 180 feet water.	

About noon was the time of day when I made the experiments at both places, and the top of the reſpective wells varying from each other depended wholly on the accidental temperature of the atmoſphere at the time; but that the thermometer at half the depth of the well at Dover gave nearly the mean heat of the top and bottom, while that in a correſponding ſituation in the well at Sheerneſs gave it colder than either top or bottom, I attribute to the following circumſtance.

Over the well at Sheerneſs a machine is erected, which raiſes the water by means of an horizontal windmill, working an endleſs chain. This chain, conſiſting of jointed double bars, with a number of buckets fixed thereon, at certain diſtances from each other, continually deſcending into, and aſcending out of the water, to an elevation of eight or nine feet above the

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* The ſand brought up from the bottom of the well by the force of the ſpring has reduced it to its preſent depth.

the top of the well, may be ſuppoſed to reduce the water as far as it reaches to the mean temperature of the air above; and thus I found it; for 51 degrees had been the mean temperature of the air near the ſea-ſhore for ſeveral days before. At the bottom of the well, near to which the chain never deſcends, I found the temperature 56 degrees; above 7 degrees warmer than that at Dover well.

The water at the bottom of theſe wells is, I preſume, too deep beneath the ſurface of the earth ever to be affected by the temperature of the atmoſphere; for if the heat of the ſummer could have had any influence on either of them, that at Dover muſt have been moſt conſiderably affected by it, eſpecially in the month of September; and the air was ſomething warmer when the experiment was made at Dover than at Sheerneſs. From the nature of the different kinds of ſtrata in which theſe wells are dug, had they been in all other circumſtances the ſame, one might reaſonably expect to find the warmer ſpring in the chalk, and the colder in the clay; but here the reverſe is ſeen, without any apparent local cauſe, except the different elevations of the ſprings in reſpect to the level of the ſea.

I am, &c.

JAMES SIX.

Canterbury,
Auguſt 1, 1787.

TABLE I.

Thermometers at different ſtations compared together.

1784	Night.			Day.			Morning.	After-noon.	Evening.	Wind.	Barometer.
	In the garden.	On the tower.	Difference.	In the garden.	On the tower.	Difference.					
Oct.	°	°	°	°	°	°					In.
1	40½	45	— 4½	56	53	+ 3	Partly clear.	— —	— —	NE	30.2
2	42	40	— 4	58	56	+ 2	Cloudy.	— —	Clear.	E	30.3
3	40	45½	— 5½	55½	54	+ 1½	Partly clear.	— —	Cloudy.	E	30.4
4	40	46	— 6	55½	54	+ 1½	Partly clear.	— —	— —	E	30.2
5	41	51	— 10	57½	56	+ 1½	Partly clear.	— —	Clear.	E	29.9
6	41	47	— 6	56	55	+ 1	Clear.	— —	— —	E	30.1
7	40	46	— 6	54½	52½	+ 2	Clear.	— —	— —	E	30.1
8	40	46½	— 6½	55	53	+ 2	Clear.	— —	— —	E	29.9
9	39½	43	— 3½	53	51	+ 2	Cloudy.	— —	Partly clear.	E	29.9
10	44½	45	— 0½	50½	49	+ 1½	Cloudy.	— —	Rain.	E	29.9
11	44	44	———	54	51	+ 3	Showery.	— —	— —	NW	30.0
12	44	44	———	55½	53	+ 2½	Showery.	— —	Cloudy.	NE	30.2
13	45	46	— 1	56	55	+ 1	Showery.	— —	— —	NE	30.2
14	44	44	———	50	48½	+ 1½	Cloudy.	Clear.	— —	E	30.1
15	31½	41	— 9½	50½	49	+ 1½	Clear.	— —	— —	NE	30.0
16	28½	38½	— 10	53	51½	+ 1½	Clear.	— —	— —	E	30.0
17	28	38½	— 10½	54	52½	+ 1½	Partly clear.	— —	— —	E	30.0
18	29	38½	— 9½	56	53	+ 3	Clear.	— —	— —	E	29.9
19	34	40	— 6	58	54	+ 4	Partly clear.	— —	Clear.	NE	29.7
20	30½	37	— 6½	54½	51½	+ 3	Clear.	Cloudy.	Clear.	NE	29.9
21	33	35	— 2	51	52	— 1	Clear.	— —	— —	NE	30.1
22	43½	44	— 0½	55½	54	+ 1½	Cloudy.	— —	Partly clear.	SW	30.0
23	43	46	— 3	56	54	+ 2	Miſty rain.	— —	Cloudy.	W	29.7
24	32½	34	— 1½	45½	43	+ 2½	Clear.	— —	Rain.	NW	29.4
25	31	30½	+ 0½	43	40½	+ 2½	Cloudy.	— —	— —	NW	29.7
26	35½	32½	+ 3	44	43½	+ 0½	Cloudy.	Rain with hail.	— —	NE	29.9
27	40	39	+ 1	47	46	+ 1	Rain.	— —	— —	NE	30.0
28	42	41	+ 1	47½	46	+ 1½	Rain.	— —	— —	NE	30.0
29	40	42	— 2	47	48	— 1	Cloudy.	— —	Rain.	NE	30.0
30	40	40	———	51	50	+ 1	Cloudy.	— —	Rain.	N	29.9
31	45	44	+ 1	50	49	+ 1	Cloudy.	— —	— —	W	29.8

TABLE II.

Thermometers at different ſtations compared together.

1785	Night.			Day.			Morning.	Afternoon.	Evening.	Wind.	Barometer.
	In the garden.	On the tower.	Difference.	In the garden.	On the tower.	Difference.					
June	°	°	°	°	°	°					In.
1	47	46	+ 1	65	59	+ 6	Showery.	– –	– –	W	29.8
2	47	48	– 1	65	61	+ 4	Clear.	Cloudy.	– –	N	29.8
3	46	47	– 1	71	67	+ 4	Partly clear.	– –	Clear.	SW	29.9
4	42½	46	– 3½	70	66	+ 4	Partly clear.	– –	Clear.	SW.NE	29.8
5	54	54	—	68	60	+ 8	Partly clear.	Cloudy.	Rain.	W	29.7
6	51	49	+ 2	61	57	+ 4	Cloudy.	– –	– –	S	30.0
7	43	45	– 2	62	58	+ 4	Cloudy.	– –	Rain.	SE	30.0
8	53½	52½	+ 1	73	66	+ 7	Rain.	– –	Showery.	SSW	30.0
9	56	55	+ 1	75	70	+ 5	Partly clear.	– –	– –	SW	30.2
10	56	55	+ 1	78	74	+ 4	Clear.	– –	– –	W	30.3
11	54	57½	– 3½	84	74	+ 10	Clear.	– –	– –	SW	30.4
12	53	57	– 4	71	63	+ 8	Clear.	– –	– –	SW.NE	30.3
13	41	49	– 8	67½	64	+ 3½	Clear.	– –	– –	SW.NE	30.2
14	42½	50½	– 8	69	64	+ 5	Clear.	– –	– –	SW.NE	30.2
15	48	53	– 5	78	73	+ 5	Clear.	– –	Hazy.	SW.NE	30.0
16	54	54	—	68	60	+ 8	Clear.	– –	– –	W	29.9
17	48	46	+ 2	61	60	+ 1	Showery.	– –	Clear.	N	29.8
18	50	49	+ 1	64	61	+ 3	Cloudy.	Partly clear.	– –	N	30.2
19	48	48	—	61	57	+ 4	Cloudy.	– –	Clear.	NE	30.3
20	45	48	– 3	65	60	+ 5	Cloudy.	Clear.	Cloudy.	NE	30.3
21	51	49	+ 2	64	59	+ 5	Cloudy.	– –	– –	NE	30.3
22	47	45	+ 2	64½	60½	+ 4	Cloudy.	Clear.	– –	NEN	30.3
23	51	49½	+ 1½	61	57	+ 4	Miſty rain.	– –	Cloudy.	NE	30.3
24	52	51	+ 1	62	58	+ 4	Cloudy.	Clear.	– –	NE	30.4
25	40	48	– 8	63	60	+ 3	Cloudy.	– –	Clear.	SW.NE	30.3
26	44½	49	– 4½	68	63½	+ 4½	Cloudy.	– –	Clear.	SW.NE	30.2
27	43	52	– 9	67	61	+ 6	Clear.	Partly clear.	Cloudy.	SW.NE	30.0
28	56	55	+ 1	70	66½	+ 3½	Partly clear.	– –	Clear.	SW.NE	29.9
29	49½	55	– 5½	72	68	+ 4	Clear.	– –	– –	SW.NE	29.9
30	50	55	– 5	75	69	+ 6	Clear.	– –	– –	SW.NE	29.8

TABLE III.

Thermometers at different ſtations compared together.

1786	Night.					Day.					Morning.	After-noon.	Even-ing.	Wind.	Barometer.
	In the meadow on the ground.	In the meadow at ſix feet.	On the tower.	Diff. between the ground and ſix feet.	Diff. between the ground and the tower.	In the meadow on the ground.	In the meadow at ſix feet.	On the tower.	Diff. between the ground and ſix feet.	Diff. between the ground and the tower.					
Oct.	°	°	°	°	°	°	°	°	°	°					In.
10	52	52	52½	——	− 0½	62	62	58	——	+ 4	Cloudy.	– –	– –	S	29.5
11	38	40	48	− 2	− 10	57	58	57	− 1	——	Partly clear.	– –	Cloudy.	S	29.5
12	51	51	51½	——	− 0½	58	57	54	+ 1	+ 4	Cloudy.	– –	Rain.	SW	29.5
13	36	37	38½	− 1	− 2½	52	51	47	+ 1	+ 5	Miſty rain.	Rain.	Clear.	NW	30 0
14	25½	28	32	− 2½	− 6½	51	51	48	——	+ 3	Clear.	– –	– –	NNW	30.1
15	31	33	40	− 2	− 9	52	50	42	+ 2	+ 10	Clear.	– –	– –	NNW	30.1
16	29	31½	36	− 2½	− 7	54	53	48	+ 1	+ 6	Clear.	– –	– –	NNW	30.1
17	33	36½	39	− 3½	− 6	50	50	50	——	——	Partly clear.	– –	Clear.	N	30.2
18	31	34	34	− 3	− 3	53	53	50	——	+ 3	Clear.	– –	– –	N	30.2
19	26	29	36	− 3	− 10	50	49	47	+ 1	+ 3	Clear.	Cloudy.	Clear.	N	30.2
20	43	44	45	− 1	− 2	48	47	47	+ 1	+ 1	Cloudy.	– –	– –	W	30.3
21	43	44	45	− 1	− 2	49	49	48	——	+ 1	Cloudy.	– –	– –	W	30.3
22	45	45	45	——	——	52	52	47	——	+ 5	Cloudy.	– –	– –	E	30.2
23	45	45	45	——	——	51	51	51	——	——	Cloudy.	Miſty rain.	– –	E	30.2

TABLE IV.

Thermometers at different ſtations compared together.

1786	Night.							Day.							Greateſt difference in the night.	Wind.	Weather.	Barometer.	In the ground in the meadow.	In the ground on the hill.	Temperature of the river.
	In the meadow on the ground.	In the meadow at three feet.	In the meadow at ſix feet.	On the hill on the ground.	On the hill at ſix feet.	In the garden at nine feet.	On the tower at 220 feet.	In the meadow on the ground.	In the meadow at three feet.	In the meadow at ſix feet.	On the hill on the ground.	On the hill at ſix feet.	In the garden at nine feet.	On the tower at 220 feet.							
	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°			In.	°	°	°
Nov. 12	23	25½	26	25½	28½	27	31	43½	43	43½	43½	42	43	41½	8	E	Clear.	29.3	42	41	42
13	21½	24	25	26	29	26	30	37	36½	37½	36	38	36	35	8½	E	Clear.	29.7	42	41½	40
14	23	24½	25	22½	23½	24	26	34	33	33½	35	38	33	31½	3½	E	Clear.	29.8	42	41	37½
15	29	29	29	28½	28½	29	28½	37	37½	38	38	38	38	38	0½	E	Cloudy.	29.7	41½	39½	38½
27	35	37	38	39½	42	39	44	48	47½	48	47	47	47	46	9	S	Clear.	30.0	42	41	43
28	44½	45	45	44½	45	45	45	51	51	51	50	49	51	50	0½	S	Rain.	29.7	47	45	47
29	37½	38½	38	38	40	38	43	51	51	51½	50	48	51	51	5½	S	Rain.	29.7	44	43	44
30	39½	40	40½	39	40	39	40	49	50	50½	49	45	43	40	1½	S	Miſty rain	29.7	44	43	45
Dec. 27	4	4	7	11	15	6½	21	43	43	42	42	42	42	44	17	S	Clear.	29.5			
29	25	26	28	29	32	27	34	40	47	51	46	47	45	46	9	S	Clear.	29.7			
31	28	29	31½	30½	31	29	35	39	40½	43	41	42½	43	37	7	WSW	Clear.	29.5			
1787																					
Jan. 2	25	27	29	26	28	28½	37	38	38	38	37	36	38	37	12	E	Clear.	30.4			
4	34	35½	38½	35	36	38	37½	44	45	46	44	44	44	44	4½	SW	Clear.	30.5			
7	24½	25½	28	27	27	26½	30½	35½	34	37	44	45	43	44	6	E	Clear.	30.5			
1[illegible]	21	23	26	28	30	24½	31	41	42	44	43	43	37	38	10	E	Clear.	29.8			
28	12	14	17	12	16	16	25	33	34	37½	—	—	36	—	12	—	Clear.	29.8			
Feb. 6	28	29	32	31	33	31	36	45	45	48	44	44	43	43	8	S	Clear.	29.9			

TABLE V.

Thermometers at different ſtations compared together.

	Greateſt cold in the night.							
	Horizontal thermometers.		Difference.	Vertical thermometers.			Difference on the ground and three feet above.	Diff. on the ground and ſix feet above.
1786	One inch above the ground.	9 inches above the ground.		Meadow on the ground.	Meadow three feet above the ground.	Meadow ſix feet above the ground.		
Dec. 31	27½°	29°	1½°	28°	29°	31°	1°	3°
1787								
Jan. 3.	33½	34	0½	33	33	34	—	1
4	37½	38	0½	34	35	38	1	4
8	21	22	1	21	22	24	1	3
11	24½	27	2½	27½	28	31	0½	3½
12	21	23	2	21	23½	26	2½	5
13	30½	32	1½	34	34½	37	0½	3
14	22½	24	1½	23	25	28	2	5
Feb. 6	27½	29½	2	28	29	32	1	4
23	18½	20	1½	19	21	23	2	4

TABLE VI.

Thermometers at different ſtations compared together.

1784	Night.				Day.				Morning.	Afternoon.	Evening.	Wind.	Barometer.
	At Chiſlehurſt.	In the garden.	On the tower.	At the ſea-ſhore.	At Chiſlehurſt.	In the garden.	On the tower.	At the ſea-ſhore.					
Oct.		°	°	°	°	°	°	°					In.
22	38	43½	44	47	52	55½	54	55	Cloudy.	– –	– –	SW	30.0
23	44	43	46	46	52	56	54	56	Miſty rain.	Partly clear.	Cloudy.	W	29.7
24	31	32½	34	34	42	46½	43	41	Clear.	– –	Rain.	NW	29.4
25	24	31	30½	33	36	43	40	40	Partly clear. Hail	Clear.	Cloudy.	NW	29.7
26	29	35½	32½	36	45	44	43	45	Partly clear.Hail.	– –	Showery.	NE	29.9
27	31	40	39	40	44	47	46	46	Rain.	– –	Cloudy.	NE	30.0
28	33	42	41	42	46	47½	46	47	Rain.	– –	– –	NNE	30 0
29	33	40	42	43	46	47	48	47	Cloudy.	Rain.	Showery.	NNE	30.0
30	33	42	40	41	49	49	50	50	Cloudy.	– –	Rain.	N	29 9
31	42	45	44	44	45	50	49	47	Cloudy.	Clear.	Cloudy.	NW	29.8
Nov.													
1	40	41	42	42	49	55	51	50	Rain.	Showery.	– –	SW	29.7
2	39	42	44	44	46	43½	49	47	Clear.	– –	– –	W	29.8
3	—	32½	35½	34	49	50	48½	51	Cloudy.	Clear.	– –	NW	29.9
4	34	34	38	37	48	48½	48	51	Cloudy.	– –	– –	S	29.8
5	32	33	38	38	43	45½	45	45	Miſty rain.	– –	– –	E	29.6
6	39	42	42½	44	44	46	43	45	Miſty rain.	– –	– –	E	29.5
7	38	42	42	42	44	46	44	46	Miſty rain.	– –	– –	E	29.8
8	27	35	36	41	39	45½	42	45	Clear.	– –	– –	S	30.0
9	27	28½	32	30	44	46	45	46	Cloudy.	Rain.	– –	S	29.7
10	37	38	40	41	51	54	54	—	Cloudy.	Clear.	Rain.	SW	29.6
11	41	49	50	—	56	54	51	57	Rain.	– –	– –	SW	29.3
12	45	50	50	48	49	56	48	56	Rain.	Clear.	– –	N	29.3
13	36	38	44	41	47	54½	51	49	Cloudy.	– –	Clear.	NW	29.7
14	31	38	41	44	53	55½	54	55	Cloudy.	Rain.	– –	NW	29.8
15	37	41	41	43	52	55	54	55	Rain.	– –	– –	NW	29.7
16	38	42	43	42	47	53½	51	49	Clear.	– –	– –	SW	29.9
17	37	40	37	39	51½	51	50	50	Rain. Hail.	– –	Clear.	NW	29.7
18	—	35	43	46	47	50	49	49	Showery.	– –	– –	NW	29.7
19	27	31	32	35	—	43½	37	41	Partly clear.	Rain.	– –	NW	29.8
20	25	29½	30	33	35	40	38	39	Clear.	Rain.	– –	NW	29.9
21	22	28	30	34	36	37	37	38	Clear.	– –	– –	NNW	30.2
22	25	27	29	29	40	40½	45	43	Partly clear.	Showery.	Cloudy.	W	

TABLE VII.

Thermometers at different ſtations compared together.

1785	Night.				Day.				Morning.	Afternoon.	Evening.	Wind.	Barometer.
	At Chiſlehurſt.	In the garden.	On the tower.	At the ſea-ſhore.	At Chiſlehurſt.	In the garden.	On the tower.	At the ſea-ſhore.					
June	°	°	°	°	°	°	°	°					In.
1	46	47	46	47	61	65	59	61	Showery.	– –	– –	W	29 8
2	47	47	48	50	61	65	61	62	Clear.	Cloudy.	– –	N	29.8
3	49	46	47	46	74	71	67	69	Partly clear.	– –	– –	SW	29.9
4	45	42	46	44	71	70	66	69	Partly clear.	– –	Clear.	SW.NE	29.8
5	52	54	54	54	64	68	60	66	Partly clear.	Cloudy.	Rain.	W	29.7
6	48	51	49	51	63	67	57	61	Cloudy.	– –	– –	S. N	30.0
7	43	43	45	45	63	62	58	60	Cloudy.	– –	Rain.	SES	30.0
8	53	53	52	54	67	73	66	70	Rain.	– –	Showery.	SSW	30.0
9	55	56	55	55	75	75	70	73	Partly clear.	– –	– –	SW	30.2
10	50	56	55	52	82	78	74	86	Clear.	– –	– –	W	30 3
11	54	54	57	57	78	84	74	85	Clear.	– –	– –	SW	30.4
12	56	53	57	55	76	71	63	84	Clear.	– –	– –	SW.NE	30.3
13	49	41	49	—	77	67½	64	—	Clear.	– –	– –	SW.NE	30.2
14	46	42½	50½	47	71	69	64	68	Clear.	– –	– –	SW.NE	30.2
15	51	48	53	51	79	78	73	76	Clear.	– –	Hazy.	SW.NE	30.0
16	51	54	54	50	63	68	60	71	Clear.	– –	Rain.	W	29.9
17	47	48	46	47	63	61	60	61	Showery.	– –	Clear.	N	29.8
18	48	50	49	51	66	64	61	64	Cloudy.	Partly clear.	– –	N	30.2
19	44	48	48	50	69	61	57	63	Cloudy.	– –	Clear.	NE	30.3
20	42	45	48	51	69	65	60	61	Cloudy.	Clear.	Cloudy.	NE	30.3
21	52	51	49	50	67	64	59	60	Cloudy.	– –	– –	NE	30.3
22	42	47½	44	51	70	64	60	62	Cloudy.	– –	– –	NEN	30.3
23	48	51	49	50	70	61	57	63	Miſty rain.	– –	Cloudy.	NE	30.3
24	44	52	51	54	69	62	58	60	Cloudy.	Clear.	– –	NE	30.4
25	45	40	48	53	70	63	60	65	Cloudy.	– –	Clear.	NE	30.3
26	47	44	49	52	75	68	63½	64	Cloudy.	Clear.	– –	SW.NE	30.2
27	51	43	52	51	71	67	61	63	Clear.	Partly clear.	Cloudy.	SW.NE	30.0
28	53	56	55	56	72	70	66	70	Partly clear.	– –	Clear.	SW.NE	29.9
29	50	49½	55	55	75	72	68	66	Clear.	– –	– –	SW.NE	29.9
30	49	50	55	57	81	75	69	67	Clear.	– –	– –	SW.NE	29.8

TABLE VIII.

Thermometers at different ſtations compared together.

	Night.				Day.		
	In the garden.	On the tower.	At the ſea-ſhore.		In the garden.	On the tower.	At the ſea-ſhore.
	°	°	°		°	°	°
1784, Dec. 10	9	15	14		21	20	27
11	5	12	12		25	22	29
25	17	21	21		33	32	33
26	23	27	27		36	35	32
1785, Feb. 7	25	28½	28		38	38	37
18	15	17	13	A little ſnow fell on theſe days.	30	31	30
21	10	15	13		38	36	36
22	17	21	16		32	33	38
25	27	31	31		44	41	40
Mar. 1	18	21	20		32	31	32
3	23	25	25		36	35	36
6	25	30	30		38	39	38

Fig. 1.

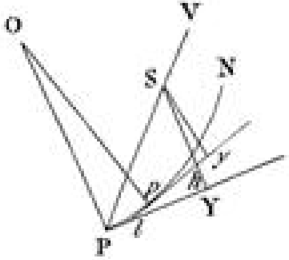


Fig. 2.

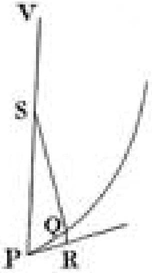


Fig. 3.

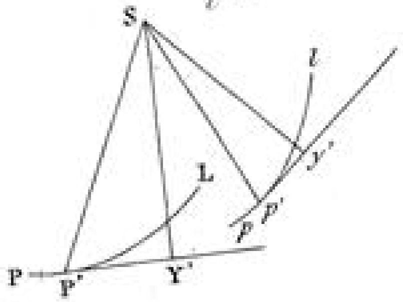
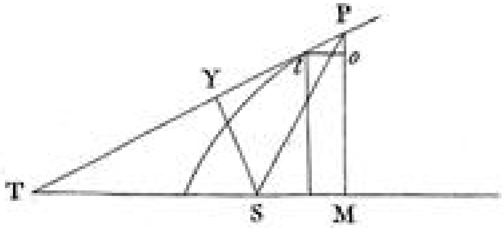
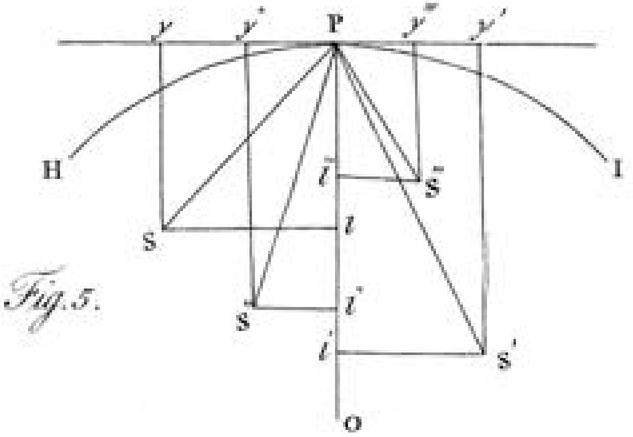


Fig. 4.





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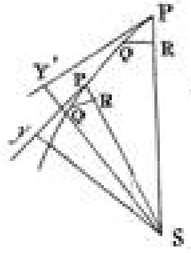
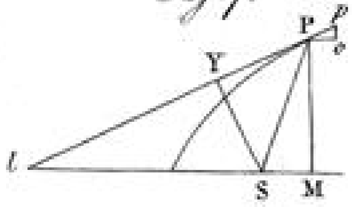


Fig. 6.

Fig. 7.



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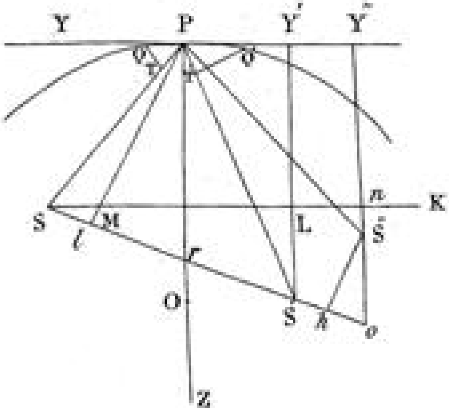

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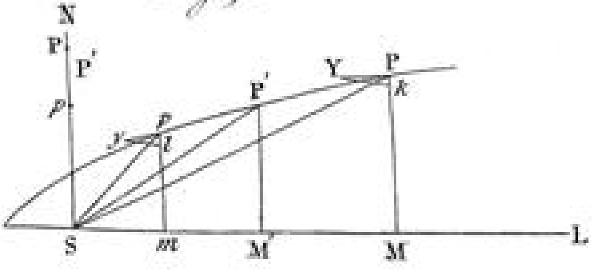


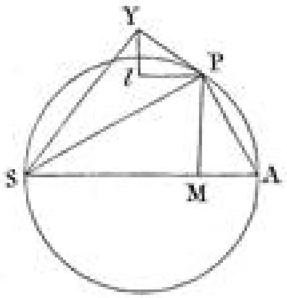
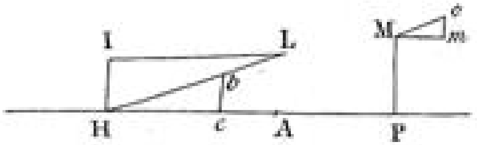


Fig. 10.

Fig. 11.



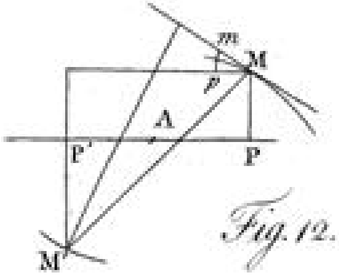


Fig. 12.